Case study on make or buy analysis in building-related installations.

Master Thesis

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Abstract

Many companies are struggling with the question of whether to insource or outsource the production or services, with the aim to maximize profitability. This paper is performed within Twence B.V. Twence B.V. is operating in the waste industry, and its main source of revenue is from waste handling and energy production. The question that is answered during this paper is; “What model can be used for a make or buy analysis for building-related installations?“. The methods that are used to answer this question are a literature study and a case study. Several models are evaluated, thereof one final (6 steps) model is created. This model is tested within the company. Out of the literature, it can be concluded that cost savings and core competence are the main reasons to perform a make or buy analysis. The outcome of the created model is that Twence B.V. can better outsource building related maintenance to maximize its profitability.

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1. Introduction

1.1 Introduction

Companies are dealing with the question whether to insource or outsource the production or services, to maximize profitability. This paper consists of a make or buy analysis for Twence B.V. referred to as Twence in the rest of the paper, is operating in the waste industry, their main source of revenue is from waste handling and energy production. The organization is located in the east part of the Netherlands and at the time of writing Twence has around 250 Full-time employees Twence (2022). Twence is having a governmental structure, many local municipalities are together the shareholders of Twence. Twence is dealing with the question of whether some processes should insource or outsourced. According to the annual report of Twence (2022) has revenue of € 125 million in 2021. The vision of Twence is described as "It is our conviction that a far-reaching reduction of greenhouse gas emissions and frugal use of our natural resources is imperative for a healthy and sustainable living environment. Raw materials in materials and products remain part of the cycle and for all products from fossil sources, there is a sustainable alternative. In the future, energy will be generated entirely from renewable sources." (Twence, 2022). Twence has raised the question of whether the maintenance of building-related installations could be insourced or still need to be outsourced in the current way. Twence is currently struggling with the aspect of defining a model to gather a well-established make-or-buy decision. The case of Twence consists of the maintenance and multi-year maintenance plan for building-related installations. Building-related installations can be seen as installations that are not directly linked to the primary process of Twence. In this paper, the choice for Twence in terms of insourcing or outsourcing is being investigated, through a case study. First of all, there will be brief literature research to see if there are existing models that can help answering this question. After the literature has provided guidance, the knowledge is tested in practice.

1.2 Research goal

This research aims to develop a make-or-buy decision model for Twence. The model can be generalized within different departments in the organization and beyond. Based on the model Twence is able to make a well-considered decision in the make-or-buy analysis.

1.3 Research question

The research question of this study is "What model can be used for a make or buy analysis for building-related installations?"

To answer this research question there are several sub-questions:

1. What is defined as a make or buy analysis?

2. What are the core aspects of a make or buy analysis?

2.1 What are the main cost drivers that are related to a make or buy analysis?

3. What models exist from the existing literature?

3.1 Which of the existing models is preferred by the literature and suitable for building-related installations?

4. How can existing models be used in a practical setting?

1.4 Research gap

The research gap that will be addressed in this research is the gap between a literature review of different methods and the practical implementation of the methodologies. The already existing implementation of the methodology is mostly performed in a manufacturing-based company while this study combines the literature with a more service-oriented make-or-buy analysis. The case study is namely not in producing products for building-related objects, but focused on the maintenance of the objects. Therefore there is a research gap between the existing literature and the implementation of a more service-oriented case study.

1.5 Empirical study

This research consists of a case study within Twence. This case is selected, because it is quite complex. It contains different installations in different buildings and is serviced based. The scope of the case study consists of the heating ventilation and air conditioning (HVAC) of all the buildings which is roughly 100 units in an industrial environment. Besides the HVAC the scope of make or buy analysis consists of the electric door opening products, lifting equipment and other smaller building-related equipment. The case consists of two elements namely the preventive part and a corrective part which is maintenance based on ad hoc failures of the installation. In addition to the maintenance, Twence is searching for an opportunity to outsource the multi-year maintenance administration plan. Twence is wondering if the market is capable of creating a maintenance plan for the coming years. Due to this complexity, the empirical study should perfectly fit with research that combines different theoretical models with a practical case.

1.5.1 Conceptual model

The research is graphically shown in figure 1, the grey circles are researched by using theoretical analysis. While the green circles are searched by empirical data in a form of an empirical study within Twence. The blue circle in the framework will be the generalized aspect of the model for other researchers and institutions.

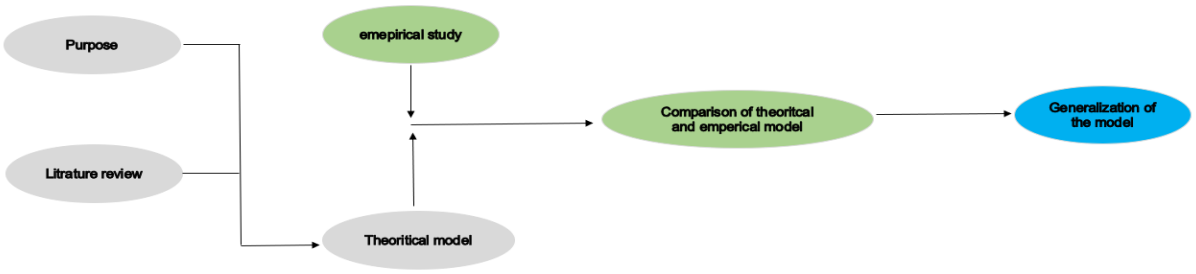


Figure 1: Conceptual model

1.6 Research structure

The research is structured as follows, In chapter 2 there will be an in-depth look at the existing literature. After all the theory is established chapter 3 will follow up an conclusion and an created model for Twence. In chapter 4 the case study will be conducted and the model will be tested. In chapter 5 the model will be reviewed and generalized for other researchers and institutions. The conclusion and discussion can be found in chapter 6 and 7. Followed by the appendix in chapter 8.

2. Theoretical framework

2.1 What are make or buy analyses?

First of all, it is good to have an idea of the definition of a make-or-buy analysis. In the research of Probert and Institution of Electrical Engineers (1997), they mentioned that make or buy is about the choice of whether to carry out a particular process or activity within your own business or to buy it from a supplier. The decision can argue in different phases for example, should a company make turbines or should it only make the engine of the turbines? The choices are about every part of the manufacturing process, not only for the whole installation. When looking at the literature it can be seen that the words make or buy analysis are strongly related to insourcing and outsourcing and are used interchangeably. Therefore in this research the words make or buy are used interchangeably within and outsourcing. In the research of Coase (1937), he asked himself the question of what determines where the production of an organization will be organized by the firm itself or where the production is set into the market. This question is later collected as the make-or-buy decision. In more recent literature there are several definitions of outsourcing. Wynstra and Axelsson (2002) define outsourcing as "the decision and subsequent transfer process by which activities that constitute a function, that earlier have been carried out within the company, are instead purchased from an external supplier". According to Ateş et al. (2015) outsourcing is the shift of existing and critical activities which are not the core competence of the organization and can belong to the resources of an external party. Oliver Williamson (1993) was inspired by Ronald Coase (1937) and further developed the make-or-buy decision with transaction-cost economics (TCE). The transaction theory is playing an important role in a make-or-buy decision. According to Rindfleisch (2019), there are three authors in different periods namely Ronald Coase in 1937 followed by Oliver Williamson in 1993, and the most recent theorist is Yochai Benkler in 2006. When looking at the development of the theory between the three authors it can be seen that the first two researchers of the development took place from the beginning of the industrial revolution till the end. While the most recent author is working in a more digital economic area. This can also be seen in the role of technology involved in the theory. In the early days, the theory is not aware of technology while in the latest the role of technology is critical. According to Benkler (2006), technology influences the market in a way that accesses information easier through the internet. Benkler (2006) also described that new markets are more social products, and predicts that companies are largely motivated by non-monetary rewards and acting in a cooperative nature. Coase (1937), was aware that there are transaction costs involved in using the market. Those types of costs should be calculated within the purchase price. Coase (1937), sees that for example information and search cost should be added to the price of the product or service. While Coase started the transaction cost theory, Williamson helped raise it to maturity. This has to do with the fact that Coase has worked on the theory throughout his academic years while Williamson has spent more time on a more steady basis on the theory.

2.2 What are the main aspects of make or buy analyses from the literature?

Out of the existing literature, table 1 is made to combine the main findings of the different literature. The main aspect that is mentioned in the literature is cost-saving, core competencies and the Strategy of the firm. Cost-saving is by far mentioned as the most important reason for conducting a make-or-buy analysis. In the following chapter, the main aspects of the literature will look into further.

Authors	Year	Concepts		
		Core competencies	Cost saving	Strategy of the company
Ellram and Maltz	1995		X	
McIvor	2000	X		
Arnold	2000	X	X	
McIvor	2003	X		
Jiang and Qureshi	2006		X	
Moschuris	2007		X	
Schwarting and Weissbarth	2008	X	X	X
leichsenring and Rodrigues	2014	X	X	
Sillanpää	2015		X	X

Table 1: Literature review

2.2.1 Strategy of the firm

When conducting a make or buy analysis the business strategy of the company needs to be taken into consideration. The research of Quélin and Duhamel (2003) says that the outsourcing decision is complex and cannot be made by an individual, it needs to contain not only operational managers but also top management. According to the research of Schwarting and Weissbarth (2008), the firm needs to have an outsourcing strategy in the current situation and for the future environment. Aspects that need to be taken into account in the strategy are the process of making or buying, the technologies, and the skills that are required to make the product or service. Besides the strategy of the firm, the product or service has also important futures that are needed to take into account when conducting a make or buy decision. Product-specific characteristics are products or services that are time-sensitive or frequently design changes. Since third parties are less flexible in changes over time. According to the research of Schwarting and Weissbarth (2008), there is also a brand aspect, e.g. the motorcycle company Harley Davidson has a brand image of being made in America. The customer doesn't care if secondary processes are outsourced, but the primary process of making motorcycles needs to be processed internally in the USA.

2.2.2 Core competencies

In organizations are different processes, and all these processes together form the core of the organization. The different processes can be distinguished by primary and secondary processes. According to the research of Prahalad and Hamel (1990), the concept of the core competency theory is established. Within this theory, the authors described three conditions. The first pillar is that the process needs to add value/ benefit to the customer or consumer, followed by the second pillar stated that the core competencies of a business need to create a competitive advantage and should not be easily imitated. The last pillar mentioned is that the core competencies should provide potential access to a wide variety of markets. This theory can be seen, for example, Walmart in the united states, they have been focused on its core competencies as a shop that sells groceries. Walmart has created a huge buying power compared to its competitors in the market. Due to the fact of massive buying capacities, it can purchase in huge quantities for low rates and be the cheapest in the market (*Walmart*, 2019). This perfectly matches the three pillars of Prahalad and Hamel (1990). As described by Fowler et al. (2001) organizations can be seen as a tree. The trunk can be seen as the primary process of the organization with the branches as the secondary process. The leaves of the tree are the end products of the organization. With this in mind, the question raises if the core competencies of a company can be outsourced or should be performed internally. Schwarting and Weissbarth (2008) described a rule of thumb that if a product or service is considered a critical component of the firm which belongs to the core process it should not be outsourced. The reason

behind this is that third-parties are less flexible to time-sensitive and frequently design changes in products. On the other hand, researchers saw an opportunity for the organization to outsource, if the production or service is capital or labour-intensive processes on the financial balance sheet. This has to do with the fact that this capital can be used differently. Outsourcing has also a positive effect on the number of workers that need to be supervised and reduces the amount of administration and training of employees.

2.2.3 Cost saving

In the research of Lackow (1999), a survey was conducted on 176 US corporations, 59% of the firms give cost savings as the main reason to outsource. The research of Quélin and Duhamel (2003) contains 25 surveys in four different countries in Europa (France, Germany, Italy and Belgium). Figure 2 from the research of Lackow (1999), shows that the most often reason for outsourcing is cost savings. Based on figure 2 it can be concluded that cost savings play an important role in facilities management. While in the R&D department cost-saving is less than 20% of the reasons, for R&D the main reason is the access to external competencies. This means that R&D can better be outsourced because the market has better competencies than housing. If this is compared to facilities management it can be seen that relying on the competencies of the market is less than 10% of the reasons to outsource. Based on figure 2 it can be seen, that outsourcing for facilities management primary reason is cost-saving.

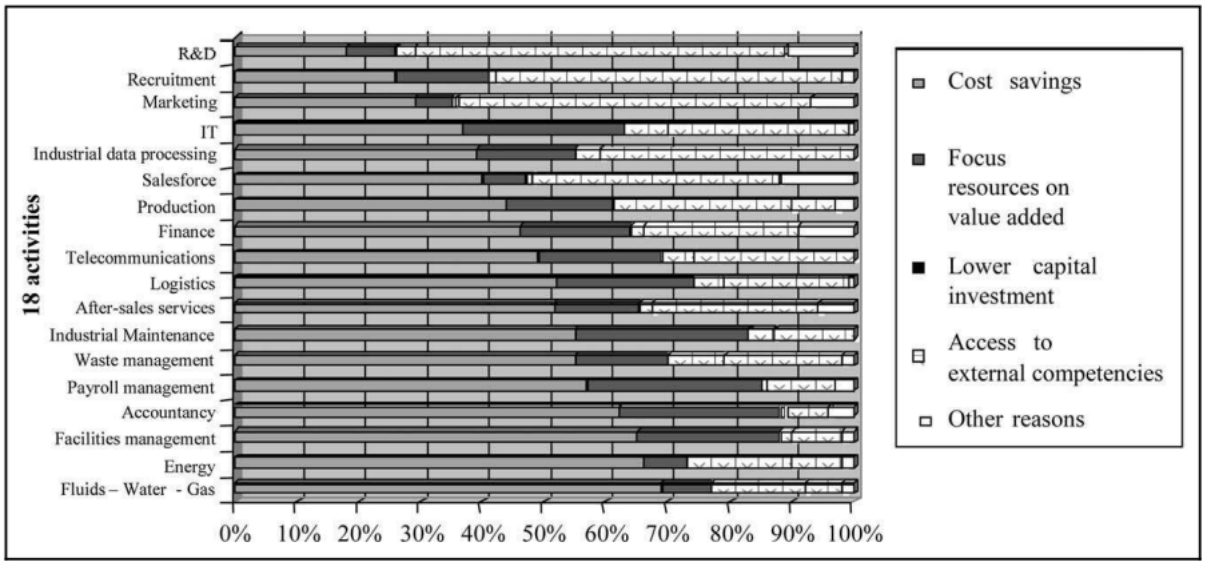


Figure 2: The main reasons for outsourcing – by activity of Lackow (1999)

While researchers also have a drawback for organizations. According to Quélin and Duhamel (2003), it stated that looking for cost savings at a short-term level may not be the optimal choice. Instead of looking at short-term savings, the company need to keep in mind the long-term perspective on the quality and reliability of the suppliers. Research conducted by Embleton and Wright (1998), found that outsourcing could lead to a competitive advantage in the long term. This founding is supported by the research of Zhu et al. (2001). Based on the literature review the main aspects of conducting a make-or-buy analysis are: Strategy of the firm, core competencies and cost savings. It is stated that cost savings are the most mentioned reason to conduct a make or buy analysis, followed by the core competencies of the organization. Based on the results of the literature review the case study will namely focus on the cost-saving aspect of Twence in the make-or-buy decision.

2.3 What models are used in theory?

The main aspects of insourcing and outsourcing decisions are discussed, and the most commonly used models in the literature can be reviewed. It can be stated that there is no standardize model for the outsourcing decision. In the literature, the models are made for specific companies. Looked at a few models, it can be seen that there are similarities. Most models are constructed as a decision tree containing the process that must be gone through to arrive at a make-or-buy decision. In figure 3 the model from Ordoobadi (2005) can be seen as a theoretical model, since the research contains a fictitious case to illustrate the functioning of the model. The model can be seen as a decision tree model in which a make or buy analysis can be made in a few steps. The model knows 3 phases, namely strategic evaluation, economic evaluation and decision analysis.

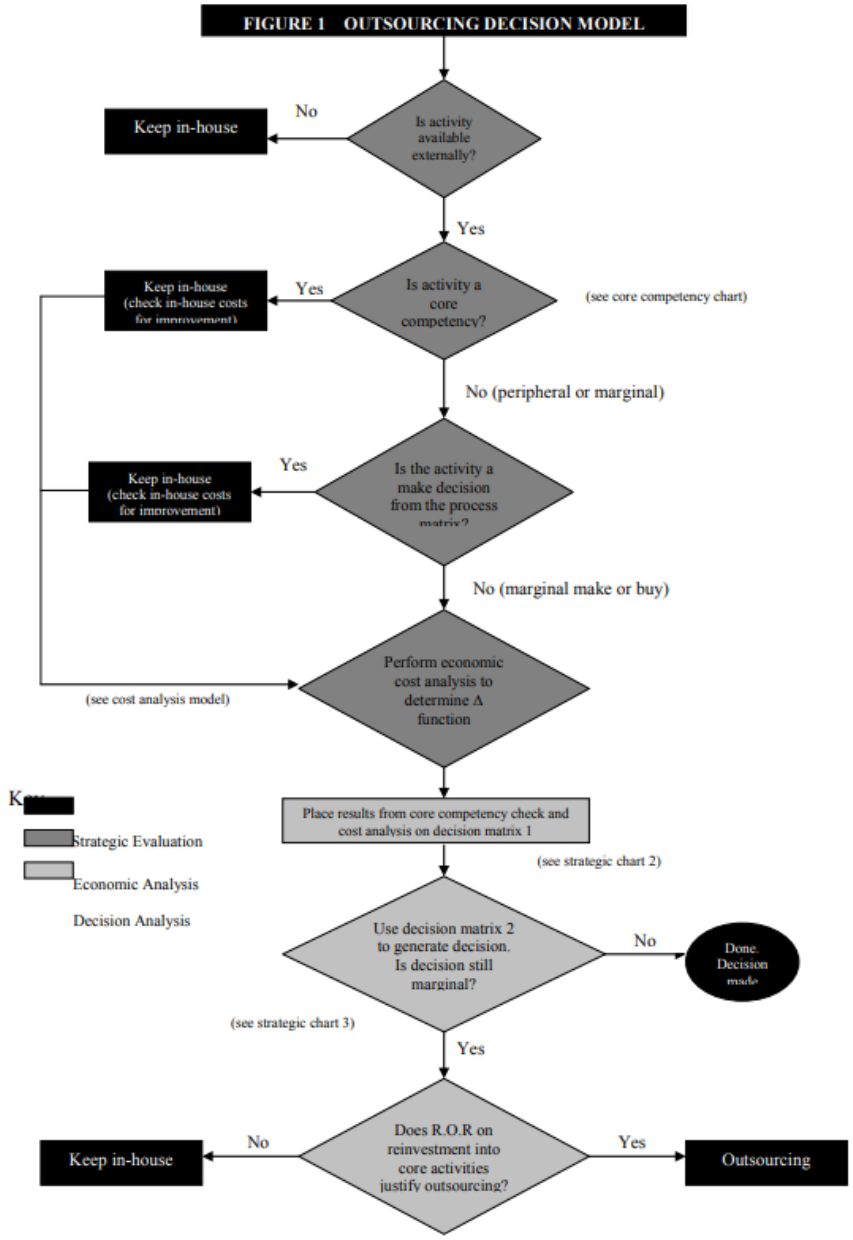


Figure 3: Outsourcing model of Ordoobadi (2005)

2.3.1 Strategic evaluation

First of all, the model look at the strategic evaluation of the firm. This involves determining the core competencies of the firm in combination with the technological position of the company in comparison with its competitors. The questions that need to be asked:

- Does the activity need highly specialized design and manufacturing skills?
- Does the activity have a high impact on what customers perceive as the most important product attributes?
- Does the activity provide potential access to a wide variety of possible future markets?

In the research of Ordoobadi (2005), they made a decision tree of the questions and resulted in high, medium or low core competency or even peripheral. The question corresponds to Prahalad and Hamel (1990) in which these core values of the company are reflected. So by answering the three questions above, an organization can decide if the activity belongs to the core process. After the company has established the strategy, they can proceed to the second phase of the model, namely the economic evaluation.

2.3.2 Economic evaluation

In this phase financial data is involved and this gives companies facts to make the difficult choice between making or buying. According to Ordoobadi (2005), there are two types of cost, namely the in-house cost element and the outsourcing cost element. The cost can be split into direct and indirect cost. Direct cost are costs that are directly tied to the production or services. Indirect cost are not directly linked to the production or services, such as overhead cost.

The in-house cost element consists of:

In-house cost elements	
Direct cost - Labour cost: this consist of only the direct labour cost. - Material cost: Consists of all the material that is used including transportation costs	Indirect cost - Capital Cost: Consists of the cost of all assets that are used in manufacturing or providing a service. - Overhead cost: Consists of indirect labour, inventory cost, quality cost and all other costs that are involved in the project or service.

Table 2: in-house cost elements

The outsourcing cost element consists of:

Outsourcing cost elements	
Direct cost - Labour cost: this consist of only the direct labour cost. - Material cost: Consists of all the material that is used including transportation costs	Indirect cost - Capital Cost: Consists of the cost of all assets that are used in manufacturing or providing a service. - Overhead cost: Consists of indirect labour, inventory cost, quality cost and all other costs that are involved in the project or service.

Table 3: Outsourcing cost elements

When all the cost are take into account the delta can be calculated, using the total cost of insourcing minus the total cost of outsourcing. When the outcome is positive, it appears that outsourcing is the cheapest option. If the outcome is negative, it turns out that insourcing is the cheapest option. This is followed by the decision analysis phase. In the paper of Ordoobadi (2005), they made use of a decision matrix with different regions to see which parts can be outsourced and which cannot. When looking at other studies with a case study from the field, it is striking that the matrix of Ordoobadi (2005) is not or hardly adopted. In practice, the decision tree is used as the main line and the underlying models contribute little to the continuation. If looked at figure 4 from the research of Ekelund and Pettersson (2010), it can see that in the first version it is still a standardized model, after which in practice it appears that the model is adapted to the wishes of the company. This is where the model differs with an extra step. In addition, figure 5 of McIvor (2003) is often mentioned as four-stage model in the literature. In the four-stage model, the questions that need to be asked are divided into four stages, which are also found in the model from Ekelund and Pettersson (2010). This overlap can be seen as a kind of generalizing model. Based on the existing literature a make-or-buy decision can possibly made in a decision tree for Twence. In chapter 3 the existing models will be merged into a new model for Twence.

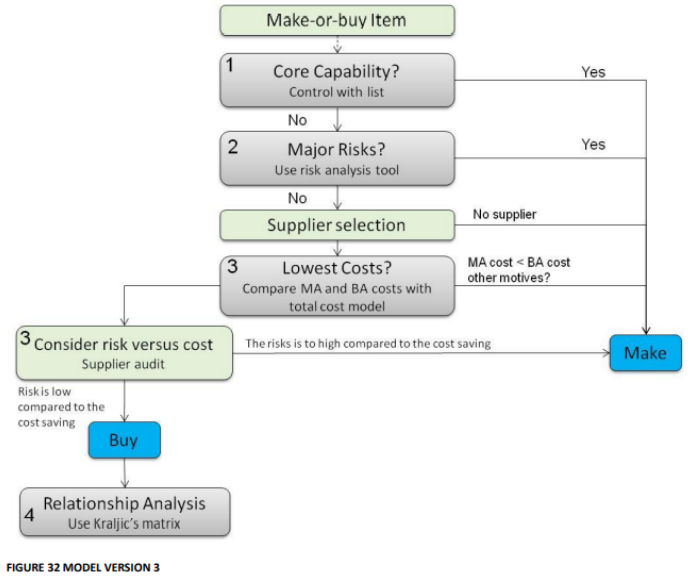


Figure 4: Decision model of Ekelund and Pettersson (2010)

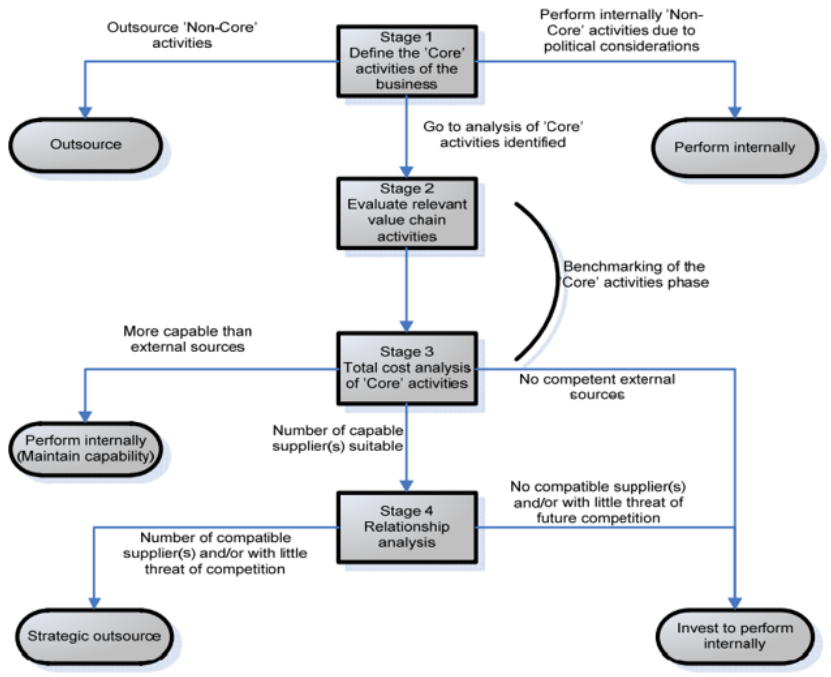


Figure 5: Decision model of McIvor (2003)

3. Methodology

3.1 Reliability of a single case study

The main question in this research is to find a model that is suitable for a make-or-buy analysis in building-related maintenance. Based on the literature review it can be seen that there exist serval general models. The existing models are merged into a new model, that is useful for building related installations. This new model needs to be established in the organisation. The methodology of establishing the model in the organisation can be done in different ways. A case study can be defined as an "Empirical inquiry that investigates a contemporary phenomenon within its real-life context using multiple sources of evidence" (Arsenault, 1998). Within the methodology of a case study Yin & Campbell (2002) defines three types: descriptive, explanatory and exploratory case studies. A descriptive case study is describing a phenomenon, while an explanatory case studies purpose is to explain how or why something happened. An exploratory case study is to identify a research topic that needs additional subsequent study. Based on the three types it is quite clear that this research can be seen as an explanatory case study of a make-or-buy analysis in building-related maintenance. Case study research has often been criticized that the findings are not generalizable in the population. Especially when comparing it to survey conducted research. This has to do with the fact that an outcome of a survey can be statically tested to show significance in the population. To make a single case study generalizable it is important that another researcher should find the same results by following the same methodology. Also it is necessary to achieve high transparency in case selection and data collection. (Yin, 2013)

When looking at the theoretical framework it can be see that the existing literature suggests three make-or-buy decision models. When looking into them, an overlap in the structure of the models is shown. All the tree models start with the question whether the activity belongs to the core process of the organization. They all suggested that when it belongs to the core process of the organisation it needs to be internally made. The three models can be combined into a new model, which can be seen in figure 6.

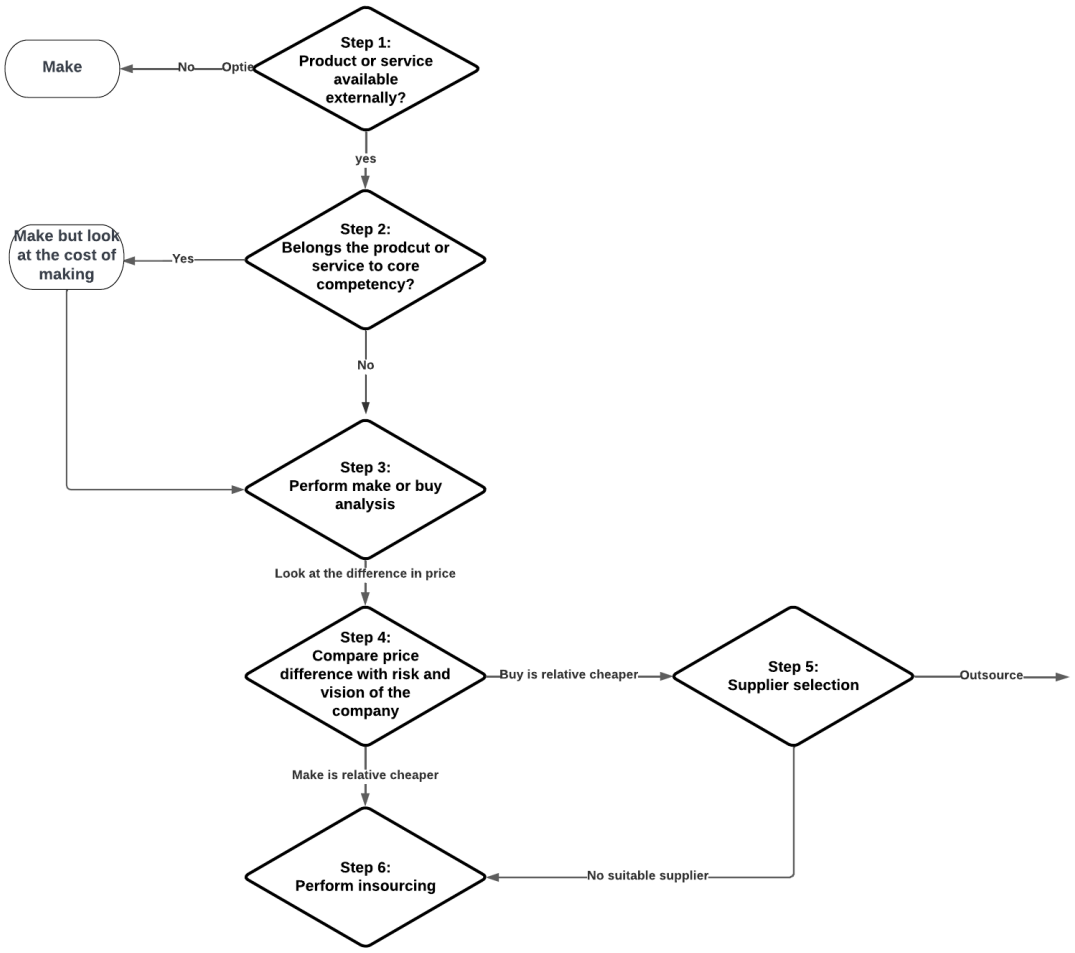


Figure 6: Insourcing or outsourcing model Twence

The first step is to find out if the product or service can be bought externally. When there are no suppliers in the market a make or buy analysis is unneeded. The second step looks at whether the product or service belongs to the core competency of Twence. According to the research of Fowler et al. (2001) core competency should be done internally, since it is curial aspect of the organisation. In the model there is a side step towards the left, for core competency. Within this side step it argues that the product or service should be insourced but within Twence some core competency are still outsourced and therefore there is an alternative route that leads to step 3. The third step consist of gathering financial data and counterbalance the data. In the fourth step the financial difference between make or buy is established. As described in the theory section cost saving is not the only aspect of conducting a make or buy analysis. According to the research of Schwarting and Weissbarth (2008), the strategy of the company and the risk needs to be take into account in the analysis. The analysis leads to an make or buy decision. When the insourcing is cheaper the model leads to step six, otherwise the model guidelines to step five. If outsourcing is chosen in the fourth step, the model leads to supplier selection. In the fifth step Twence should consider whether the available parties are also suitable parties. It can occur that the standards of Twence wouldn't fit the standards of party and therefore there is an alternative route that leads to step 6. When insourcing is chosen in step 4, the model goes directly to step 6 to concluded that the product or service should be insourced. This conclusion can also occur when Twence didn't found a suitable party and decide to insource. The

expectation according to the literature is that outsourcing would be better for a company. In chapter 4 a case study is performed to see if the expectation out of the literature study can be confirmed.

4. Results

After demonstrating the outcome of the literature review in figure 6, a case study is conducted. First of all, the scope of the tender and tender process of Twence is illustrated. After the sample is known the model will guided in order to arrive at the make or buy decision.

4.1.1 Introduction of Twence

Currently, Twence is outsourcing building-related maintenance to the market. As described in the introduction Twence is a semi-governmental organization and therefore it must contract out its services under the 2012 Public Procurement law. Under that law, an organization must make use of a tender when the expenses for four years will arise the €[redacted]. When the purchase intention has reached the threshold it should use the tender methodology. This tender will be made public through the Negometrix platform.

4.1.2 The scope of tender

To put out to tender, Twence investigated what should be contracted for the building-related installations. The scope of the contract covers maintenance management (condition versus costs), preventive maintenance (scheduled inspection and maintenance work), corrective maintenance (resolving malfunctions), and replacement maintenance in the form of a multi-year maintenance plan and modifications. The scope of the tender includes air-treatment units, down/up flow units and other smaller parts of the buildings of Twence. The plant of Twence consists of different buildings where the first building was released in 1996 while the second part was released in 2011. Twence is seeking a long-term and dynamic contract. Twence wants to find a long-term partner for a planned contract duration of 10 years. In so doing, the supplier must be able to provide multiple services within the scope. Twence vision is that the company should be able to perform as many services as possible itself so that they will be cheaper and the company will have more influence on its services. Beyond the execution, Twence believes that direct communication with the contractor will lead to greater efficiency.

4.2 Case study

From the theory, several models have been looked at and merged into figure 6. Within this new model there is an large overlap between the already existing literature. This model is now being used as a guide to go step by step through the make-and-buy analysis.

Step 1: Available externally

The model starts at step 1, with the question of where the product or service is available externally. This has to do with the fact that when a product isn't available externally it is unnecessary to perform a make-or-buy analysis.

Tender process

As described in the introduction Twence needs to use a tender procedure to fulfil their purchase intention. This leads to an Tender process which is quite difference than a normal purchase intention. On 9th of May 2022 an Negometrix tender is opened via the platform. Within the tender Twence has described the scope in detail. This has been done to provide the potential supplier an good understanding of the organisation. Twence has submitted specific wishes to be considered in the selection process. The first wishes of Twence are called references of the service provider. Based on references, Twence should be able to assess whether a company is capable of providing its services at

Twence. In the references part, some aspects of the reference are taken into account such as Breadth and scope of service but also the type of contract and the environment in which the services are done. The second wish of Twence is the view from the potential supplier towards an performance-based partnership contract. This has to do with the fact that Twence is currently in a transition phase from a more standard effort-based contract to an performance-based contract.

Sampling the tender

As shown in figure 7, the model starts with the publication phase, within this phase the potential suppliers can applicate on the tender. This results in 32 applications shown in figure 7, but only five companies actually complied to the request of Twence and therefore are accepted. This reduces the sample size to only 5 companies that enter the selection phase. Within this phase a multidisciplinary team of Twence staff is grading the submitted documents. Normally the top five companies will pass the selection phase, but due to the lack applications all five will pass. Right after the selection phase two companies had to withdraw them self out of the tender due to lack of technical employees. This reduces the sample size to three. All the three companies are allowed to submit their offer which consist of an presentation at Twence, a plan of approach and a customer portal. The offers will be evaluated individually by the members of the multidisciplinary team. A point of interest is that the submitted price of the suppliers are not visible for the team. This leads to an evaluation purely based on the quality of the offer. The evaluation team is grading the offers by adding a notional discount per supplier. Based on the methodology a price versus quality outcome will receive, where the most expensive party can still win due to receiving notional discount. This will results in a ranking of the suppliers where the cheapest party will be the winner of the tender. The tender shows that three parties would like to offer their service for Twence. Therefore, it can be concluded that the service is available externally.

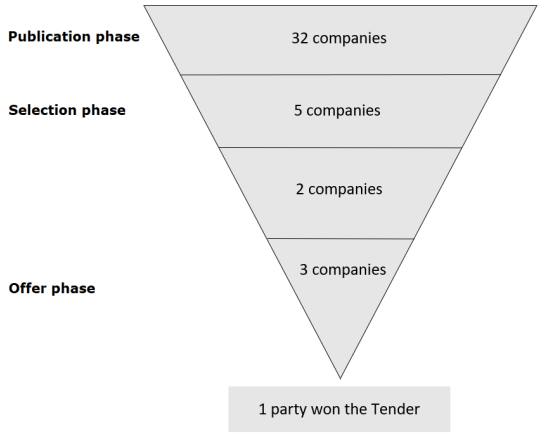


Figure 7: Tender process

Step 2: Core competency

As the theory described core competencies should not be outsourced since they are so important to the business. When conducting interviews within Twence, it was quite surprising that core competencies are being outsourced which is not in line with the theory. Therefore the model for Twence is making a side step to the left, which argues that when a product or service belongs to the core competency of Twence still can be outsourced. This leads then to the consideration of still outsourcing or not. It can be seen as an alternative route in the model to reach the next step which is performing a make-or-buy analysis.

Step 3: Performing make or buy analysis

Performing a make-or-buy analysis is the most time-consuming part of the analysis. Within the analysis, the price of the tender will be compared to the internal price. This price comparison should be done on individual products or services and the overall cost of the insourcing or outsourcing. Within the case study of Twence, the price of the outsourcing parties is already known due to the fact of the tender. When having the prices of the outsourcing aspect it is necessary to look within the organization at what the internal price is of the tender. First of all the price of outsourcing will be discussed in detail and followed by the insourcing price.

Buy analysis

As described in step 1, Twence is using Negometrix platform to evaluate the suppliers and based on evaluation on quality and price, cheapest suppliers is the winner of the tender and therefore will be used as the outsourcing price.

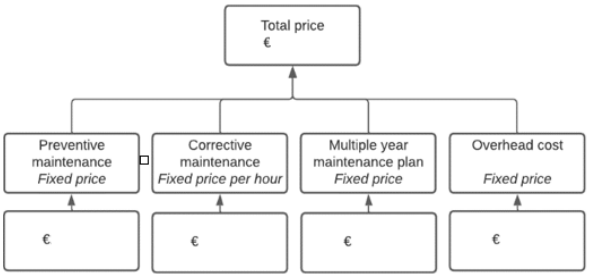


Figure 8: Price overview tender

The total price of the tender can be estimated at € [redacted]. This price contains preventive maintenance, corrective maintenance, multiple-year maintenance plan and overhead cost. Each price component will be discussed in detail. First of all, an contract change in redeeming failures need to be addressed.

Redeeming failures

The 2021 contract includes a surrender arrangement. This arrangement hits maintenance below an amount of € [redacted] may be considered preventive maintenance and is not charged. For this, a fixed price of € [redacted] was agreed upon. Subsequent analysis shows that the supplier incurred costs of € [redacted]. This results in an overpayment of € [redacted]. Based on this experience in the past the new tender will not include a buy-out arrangement. Due to this contractual change, the following needs to be corrected for 2021. The total amount of preventive maintenance should be reduced by € [redacted] in costs. while on the corrective side, maintenance should be increased by € [redacted]. Overall, nothing happens on the outsourcing side.

Preventive maintenance

Preventive maintenance can be seen as maintenance of installations to prevent failure. This maintenance is done on regular basis, based on recommendations from the supplier and experiences from the past. The time interval can be disputable, the thinking behind this is a decline in preventive maintenance will increase the overall amount of failures which leads to higher corrective maintenance. Based on the experience of Twence and the recommendations from the installation supplier the offering organisation can describe in detail per asset how much preventive maintenance is needed and the price of it. The price aspect of preventive maintenance is a fixed price all-in price. For each asset, the all-in price is known, which resulted in a total price for preventive maintenance of € [redacted].

	Tender proces	
	Tender	Ratio
	2023	
Total cost	€	%
Hours cost	€	%
Material cost	€	%
Amount of hours		
Hourly rate	€	

Table 4: Tender preventive maintenance

As shown in table 4, the total cost is split up between hours cost and material cost. The hour cost consist of [redacted] working hours at an hourly rate of € [redacted]. The material cost are € [redacted].

Corrective maintenance

Corrective maintenance falls under the category of ad hoc maintenance. This maintenance is unplannable and the vision of Twence is that it should be minimalised. Therefore the target of Twence is to reach condition three for all installations according to the NEN2767 norms (NEN, 2019) . The NEN2767 is a condition measurement for building-related installations (NEN, 2019). For corrective maintenance, it is unable to create a fixed all-in price for Twence. This has to do with the fact that the maintenance is unplannable and unsuspected. Given that no information is available for 2023, the analysis would use 2021 data as input.

	Previous year		Tender proces	
			Tender proces	Ratio
	2021		2023	
Total cost	€	%	€	%
Hours cost	€	%	€	%
Material cost	€	%	€	%
Amount of hours				
Hourly rate	€		€	

Table 5: Tender corrective maintenance

Based on the year 2021 it can be seen that € [redacted] is registered for corrective maintenance. In 2023 the total price need to be corrected due to modification in the contract. In 2021 there was agreement between the supplier and Twence that small maintenance below [redacted] will not be charged and an additional € [redacted] will be added to the contract. This agreement is no longer valid for 2023 and therefore should be added by the price of the new contract. Given that the new total price for 2023 can be estimated at € [redacted]. This hold when the assumption is made that the amount of work and the amount of hours doesn't chance but only hourly rate increases. This assumption can be seen as realistic due to the fact that the ratio between material cost and hourly cost doesn't change much.

Multiple-year maintenance plan

The multiple-year maintenance plan is an ongoing reporting cycle about the maintenance for the upcoming years. This reporting can be seen as the service part of the tender. The philosophy of having this included in the tender is that the supplier is knowing the installation better than Twence does because the supplier is physically working with them. Based on the experience of the supplier they can make an expected maintenance plan for the upcoming years. Twence stays in the lead to manage the amount of maintenance and their investment portfolio for the upcoming years. Creating the multiple-year maintenance plan is currently done with the supplier's online web-based information system, within this system the maintenance worker can add information about the condition of the installation and the maintenance. This information is real-time visible for Twence. For

this information system and multiple-year maintenance plan, the supplier has estimated € [redacted] per year. This includes the implementation and actualisation.

Overhead cost

Overhead costs consist of different types of costs which are not directly related to maintenance. Within the overhead cost, there are two main types of cost namely the condition measurement also known as zero measurement and overhead costs such as reporting and overhead personnel cost such as management meetings. Within the tender, the costs of € [redacted] can been broken down into € [redacted] for zero measurements and € [redacted] for the rest of the overhead cost.

Financial summary outsourcing methodology

The overall pricing per asset can be seen in the table 6.

Preventive Maintenance		
- Fire extinguishers	Fixed price	[redacted]
- Overhead doors	Fixed price	[redacted]
- Valves	Fixed price	[redacted]
- RWA	Fixed price	[redacted]
- Airconditioning units	Fixed price	[redacted]
- Hosting equipment	Fixed price	[redacted]
- HVAC	Fixed price	[redacted]
- Lifts	Fixed price	[redacted]
- boilers	Fixed price	[redacted]
Total preventive maintenance	Fixed price	[redacted]
Corrective maintenance	Variable price	[redacted]
Multiple-year maintenance plan	Fixed price	[redacted]
overhead cost	Fixed price	[redacted]
Total		[redacted]

Table 6: Summary of prices tender

Thanks to the four cost streams and assets-specific cost prices, Twence has good insight into the various costs of the tender. Based on the results of the tender it can be concluded that the buying aspect has a total price of € [redacted]. In the next chapter, the make the methodology of the make-and-buy analysis will be discussed.

Make methodology

When looking at the insourcing decision it's necessary to investigate what is needed to fulfil the requirements of Twence. While Twence has described in detail what is expected from the contracting party, this can be used as a guideline. Besides the scope of the tender, the current supplier has four different revenue streams. In the tender, it is in detail described corrective and preventive maintenance work, beside that the current supplier is also working on investment and substitution of installations. This falls out of the scope of the tender and therefore will not be taken into account in the make-or-buy analysis. First of all the employee hourly rate will be established. This hourly rate will contain all the costs of the insourcing decision.

Employee rate

When calculating the making aspect the hourly rate for maintenance work needs to be established. This is an quite important aspect because a high percentage of the cost of the tender is due to

employee costs, especially for the maintenance worker. Therefore the hourly rate should be calculated precisely and all the overhead costs should be discounted back in the hourly rate.

Working hours

First of all, it needs to be calculated how many effective hours a technician can worked in a year. The calculation starts with the number of hours that the employee is working on a contract based. For a maintenance technician, this is set as 1600 hours per year. The number of hours should be deducted by the amount of sickness absence, according to internal documents Twence (2022) this rate can be set as [redacted]% of the working hours. Besides the sickness absence, there are also [redacted] training hours needed to keep the maintenance engineer up to date about the lasted regulations and laws within their job. This results in [redacted] effective hours per year.

Direct cost

In the case of Twence the direct costs are the costs that are involved of hiring an mechanic engineer. In table 7 all the direct costs are summarised and summed up to an total of € [redacted] per year.

Direct cost	
Employer expenses	€
On-call duty	€
Traning/ certification	€
Working clothes	€
Telephone	€
Workplace	€
Company van	€
Tools	€ +
Total direct cost	€

Table 7: Direct personnel cost

Employer expenses contributes most to the direct cost. This has to do with the fact that Twence is willing to hire an mechanic that can be seen as an maintenance engineer that is classified in salary scale H. (Twence, 2022) The € [redacted] employer expenses consist of monthly paid salary + [redacted]% extra budget due to heavy work + employment agreement holiday of [redacted]% + employer's social security contributions + pension contributions. Beside the regular working hours Twence is operation 24/7 so there is an extra on-call duty premium paid to the maintenance engineer of € [redacted] per year. According to internal document Twence (2022) an trainings program is developed to keep knowledge internally, this training program will cost € [redacted] and is directly related to the maintenance engineer. According to the research of Colliers (2021) the cost of a workplace is estimated at € [redacted] per year. Last of all the maintenance engineer has own equipment such as working clothes, telephone, van, tools and can be estimated at € [redacted] per year.

Indirect cost

Besides the directly related cost, there are also indirect costs that should be related to the maintenance engineer. The indirect cost will be discounted back to the hourly rate of the maintenance engineer. The main part will be the cost of a new information system. As described in the outsourcing methodology the supplier is delivering this system. When doing this internally there is some cost that should be made due to license fees. According to internal document Twence (2022) his is estimated at € [redacted] per year. Besides the license fees, there are also development

expenditures that can be estimated for a time frame of 3 years of € [redacted] which is equal to € [redacted] per year. When the whole information system is set the information should be actualised and updated frequently. Based on the experience of the outsourcing party the actualisation and updating will cost around [redacted] hours per year, which means that Twence will have an additional cost of € [redacted] per year. Within the tender, it is described that every year the installation should be checked and the conditions should be measured. This yearly condition check cost can be estimated at € [redacted]. This brings the total indirect costs to € [redacted].

Indirect cost	
Information system	€
Setup cost system	€
Actualising information	€
Condition measurement	€ +
Total indirect cost	€

Table 8: Indirect cost

Total cost

When the direct cost and indirect cost are specified, the total cost can be calculated by summing both cost types. This results in a total cost of € [redacted] per year per maintenance engineer. When dividing the total cost by the number of effective hours it can be see that the cost per hour is € [redacted]. This has mainly to do with the fact that a lot of hours are spent on training and certification. When the hourly rate has been established the price comparison can be made.

Total direct cost	€
Total indirect cost	€ +
Total cost	€
Effective hours	
Cost per hour	**€**

Table 9: Hourly rate insourcing

Preventive maintenance

Preventive maintenance is done with the mindset of extending the life of the installations. As described in table 4, the supplier expect 374 hours need to be used for preventive maintenance. For the make analysis it is assumed that the amount hours will stay the same for either make or buy. Therefore the hourly rate can be estimated at € [redacted] The material cost is based on the data from previous years plus an indexation. According to the research of CBS (2022), the indexation rate can be set at 11,7% for 2023. This will bring the total cost of preventive maintenance to an total of € [redacted], which can be seen in table 10.

	Make analysis Twence	
	Insourcing	Ratio
	2023	
Total cost	€	%
Hours cost	€	%
Material cost	€	%
Amount of hours		
Hourly rate	€	

Table 10: Insourcing preventive maintenance

Corrective maintenance

As described in the outsourcing methodology it isn't able to predict the amount of corrective maintenance for the upcoming years. This has to do with the fact that it is ad hoc maintenance and could not be predicted For insourcing corrective maintenance, it is necessary to look at the reported numbers for 2021 and build an estimation on it. The number of hours in corrective maintenance will hold constant. The 1001 amount of hours will be multiplied by the new hourly rate of € [redacted] which results in a total hours cost for corrective maintenance of € [redacted]. For the material cost, the amount is estimated at € [redacted] due to an indexation of 11,7%. (CBS, 2022) This leads to a total cost for insourcing corrective maintenance of € [redacted].

	Make scenario Twence	
	Insourcing	Ratio
	2023	
Total cost	€	%
Hours cost	€	%
Material cost	€	%
Amount of hours		
Hourly rate	€	

Table 11: Corrective maintenance

Multiple-year maintenance plan

The multiple-year maintenance plan can be classified as the service part of the Tender. Within the tender, it is described as an ongoing reporting dashboard. This dashboard consists of the maintenance plans for the upcoming year As described Twence is currently making use of the reporting system from the supplier. This reporting program is called Planon. According to the research of Triquet and Clarke (2022), Planon is the market leader since 2017 in integral real estate. This is in line with the vision of Twence to lift with the knowledge of the market. When insourcing the multiple-year maintenance plan it can be stated that Twence needs to rely on his reporting system. Twence is currently working with SAP, SAP is a general ERP system. The reporting tool from SAP isn't currently used within Twence. Twence's reporting will be done via Qlik senses. To insource a multiple-year maintenance plan Twence should invest in a new system such as Planon or Prequest. According to the verbal offer of Prequest, the price for an information system and space management program can be estimated at € [redacted] yearly basis. This amount is already included in the hourly rate and their fore should not be counted twice.

Overhead cost

In the case of Twence the overhead costs can be seen as an indirect cost and are discounted into the hourly rate of the maintenance engineer, as shown in table 9. Due to the fact that all overhead cost are discounted in the hourly rate, there is no general overhead costs in the calculation.

Financial summary insourcing

In table 12 the financial results of insourcing are summarised. It can be seen that there are only 2 cost drivers because the multiple year maintenance plan and overhead cost are discounted in the hourly rate. Therefore the insourcing cost will contain the preventive and corrective maintenance which is summing up to € [redacted].

	Insourcing
Preventive maintenance	€
corrective maintenance	€
Multiple year maintencance plan	€
overhead cost	€
Total make cost	€

Table 12: Financial summary insourcing

Step 4: Comparison of price differences and risk involved

As described in the model methodology this step is used to make a comparison between the price difference between insourcing and outsourcing compared with the amount of risk and the vision of the company. First of all, the comparison will start with a financial analysis of the price difference. Followed by the risk and vision of Twence in the comparison.

Financial comparison

In table 13 it can be stated that there are some price differences compared to insourcing and outsourcing. What breaks down is that insourcing consists of only two streams namely preventive and corrective maintenance while outsourcing also consists of a multiple-year maintenance plan and overhead cost. This has to do with the fact that for insourcing both costs are discounted back into the hourly rate of the maintenance worker.

	Insourcing	Outsourcing	Difference
Preventive maintenance	€	€	€
corrective maintenance	€	€	€
Multiple year maintencance plan	€	€	€
overhead cost	€	€	€
Total make cost	€	€	€

Table 13: Financial comparison

When summing up all insourcing costs it will result in € [redacted] for the year 2023. Compare to the outsourcing price it can be seen that there is a price difference of € [redacted] in favour of the outsourcing decision. This means that outsourcing results in a cost beneficial of € [redacted] compared to insourcing.

Risk and vision of Twence

As described above the financial differences are in favour of outsourcing, but hold this favour when taking in to account the risk and vision of Twence? Based on internal interviews (see Appendix A), there can be seen two main risk factors, namely the risk of getting the right employee and the risk of acquiring the knowledge and the associated regulations of the installation of Twence. At first, there is looked at the risk of getting suitable employees.

Risk of employee

According to the research of Jessie et al. (2017), there is an expected labour shortage in the engineering and care branch by 2022. According to the research, the main factor is that there is a shortage of people that are willing to work in the technology sector. When currently at the research of Rovc (2022), the number of outstanding job vacancies in the technical sector, it can be seen that the prediction made in 2017 is quite realistic. This implies that in the current situation and future, Twence will have to become concerned about recruiting technical staff. This means that Twence is

facing the risk of attracting suitable employees for the make-or-buy analysis. This means that Twence need to put extra effort in gaining suitable technical employees.

Knowledge and regulations

As described, Twence currently make use of the supplier's knowledge and skills. If Twence decides to do this internally, Twence would have to train staff for this. Staff training can be seen as very time intensive. In addition to the training of employees, the employees would also have to be trained annually and keep up to date of the various laws and regulations. Looking at the current tender, it is noticeable that there are already at least 30 different standards and guidelines for the plant at the first moment. The staff would therefore have to pass 30 different courses/certificates to be allowed to carry out maintenance. As described, the staff would also have to keep an eye on these standards for law changes.

Vision of Twence

According to the internal purchasing strategy it can be seen that Twence is willing to maximize profit margin due to the use of Total cost of ownership and to guarantee the continuity of the organisation (Twence, 2022). When looking at the financial difference it can be seen that Twence favour to select the outsourcing option only based on the willingness to maximize their profits. When adding the guarantee of the continuity of the organisation in the decision, Twence argues that they want to minimalize the risk of discontinuation. This minimalizing of the risk can be achieved due to the transfer of the risk to a third party, namely the supplier. This means that Twence doesn't need to find suitable personnel and doesn't need to invest in certification and keep on track with the latest laws and regulations. This will be outsourced to the supplier and Twence can focus on the core competency of their business namely producing energy.

Decision

When comparing the financial difference it can be stated that outsourcing is gaining towards maximizing Twence profit margin but the vision of Twence and the risk that is involved should also be taken into account. Looking at the risk it can be seen that the risk will increase when Twence is insourcing, due to the lack of suitable personnel and the risk of discontinuation due to the internal level of knowledge about changes in laws and regulations. This is in line with Twence's vision to benefit from the knowledge and expertise of the market. Therefore the comparison step will concluded that outsourcing is cheaper than insourcing plus the vision and risk are both supporting the choice of outsourcing.

Step 5: Supplier selection

Within the step of supplier selection, the risk is argued that there is no suitable supplier in the market that Twence is willing to work with. This step can be seen as the last escape route to prevent an outsourcing decision. In the case of Twence it can be argued that there are three suitable suppliers in the market. So based on the Tender, there is no reason to query the suppliers and therefore the conclusion made in the step 4 is supported. Twence should therefore choose in this case study for outsourcing.

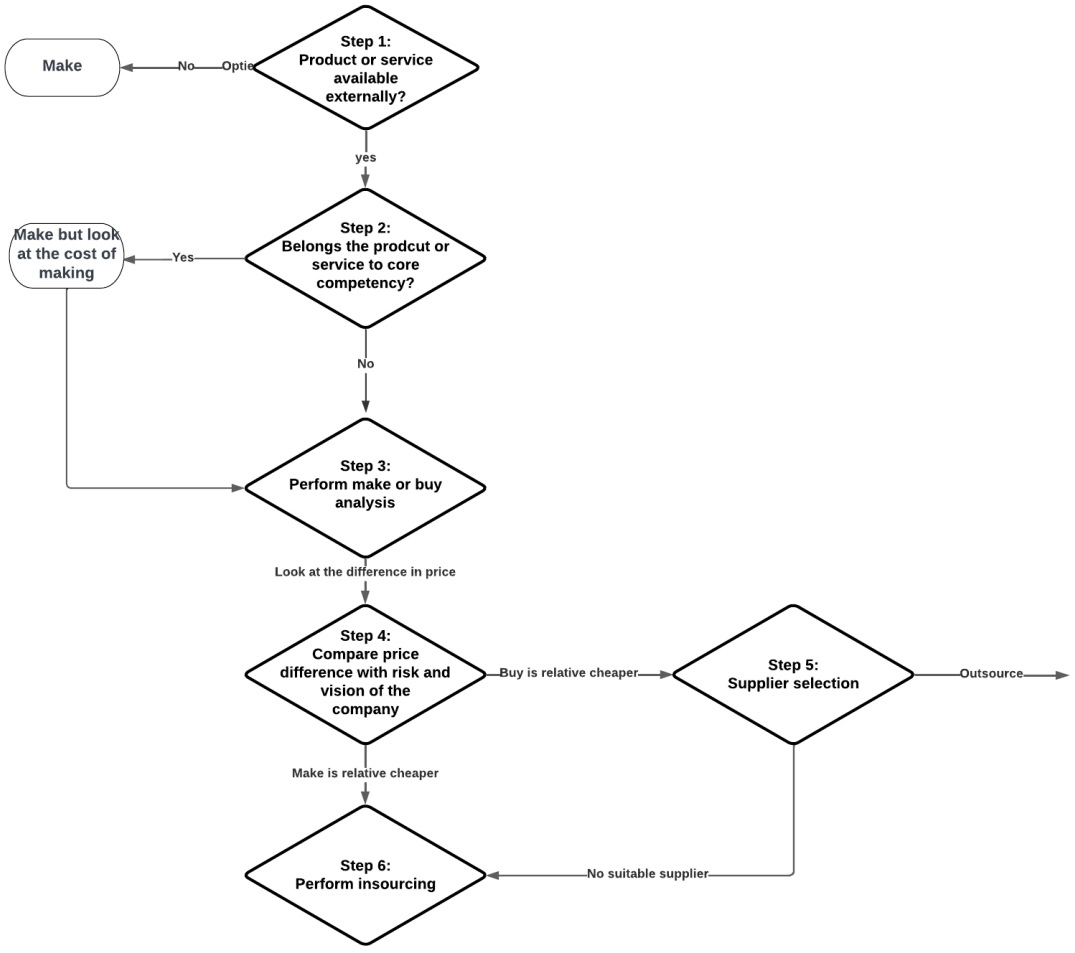
Summary Case study

Now that all the steps of the model have been completed, a conclusion can be drawn. First, it can be seen that the case study adheres to the steps of the model and no additional steps have been taken. Notice that step 3 performing make or buy analysis is the biggest step, this is caused by some empirical data calculations. This shows that based on financial data, the preference is outsourcing. After step 4 looks at whether this is in line with the associated risks and Twence's strategy. This shows that both the strategy and the risks both come in favour of outsourcing. This is ultimately followed by

step 5, which looks at whether the market parties that offer themselves are also suitable in terms of Twence's standards and values. After all, Twence has a sustainable character and wants to see this reflected in its suppliers. Within this step, Twence sees no reason to refrain from outsourcing because three good market parties have presented themselves. After which the choice was made to work with the best price-quality ratio partner. According to the model, this would yield financial savings of approximately €[redacted].

5. Review model Twence

This chapter evaluates the working of the new created model for Twence. Within this, a reflection would be made on the functioning of the model during the case study and look at the generalisability of the model.



Step 1: Evaluation available externally

Step 1 is focusing on if the product or service is available externally. When the product or service isn't available externally it should be done internally. In the case study, it is described that Twence is working with a tender. This means that Twence purchase intentions need to follow the tender

methodology. For the case study building-related maintenance a tender is performed and three parties can offer the services, therefore, there is no need to argue that the services are not available externally. When Twence is generalizing the model within the organisation and beyond the researcher need to raise the question for each component that is in the make or buy analysis.

Step 2: Evaluation core competency

When looking back at the case study it can be seen that building-related installations don't belong to the core competency of Twence. The core competency of Twence is waste handling and producing energy. Based on that the building-related installations are not part of the core business of Twence. To generalise the model within Twence, it is interesting to test cases with an core competence. To test the model, an interview with the manager of the asset department is conducted. When interviewing it was quite surprising that some core competency of Twence is being outsourced. For example, the maintenance of the turbines of Twence is being outsourced. Turbines are machines that can transform steam into energy. The turbines can be classified as the core competency of Twence this has to do with the fact that turbines are creating energy. Therefore it was surprising that the maintenance of these crucial machines is outsourced. Manager of Asset argues that the theory makes sense but that Twence differs in this aspect. This has to do with the fact that the turbines are so complex that the supplier has more knowledge and expertise than Twence. On the other hand, Twence is having a department of legal and finance, this doesn't belong to the core competencies because it is a supporting department within Twence. When looking at the created model it should be outsourced because it doesn't belong to the core competency of Twence. The financial director argues that the processes within the department are too complex to outsource. Since the legal is quite complex material and in combination that Twence needs to make use of the tender methodology. The financial director argues that the financial and legal departments are specific departments, that cannot be outsourced due to the characteristic of each department. This confirms the theory section, which stated that product-specific can have an important role in the make or buy analysis. When product-specific characteristics are frequently changed or complex it could affect the make or buy analysis. When reflecting on this model it can be seen that different cases lead to different answers when following the model. This has to do with the fact what is defined as a core competency. Based on this experience within Twence the model has created an escape route, to prevent the insourcing of core competency for Twence.

Step 3: Evaluation performing make or buy analysis

After the choice is made in step 2 it leads to performing a make or buy analysis in step 3. This step can be seen as the most time-consuming aspect of the model. During the case study, the contracting party was leading in categorising costs. This created different cost categories. These categories were then used to map the insourcing cost. Thanks to this methodology, it is possible to see where the differences are at both the total level and category level. During the case study, the overhead and multiple-year plan costs were discounted at the hourly rate. This was chosen to provide a clearer estimate based on the hourly rate. Step 3 is probably difficult to generalise because each make-or-buy analysis requires its financial cost overview. As a result, no generalisable calculation model can be made for this step. However, a standardised cost overview can be created from theory, which can be applied to different cases. However, every make or buy analysis requires insight into all financial costs arising from both make and buy.

Step 4: Evaluation comparison

Step 4 is the step comparing insourcing and outsourcing. The case study looks at this in three different aspects, namely financially, Twence's strategy and possible risks. Looking at the case study, the focus is mainly on financial comparison. Here, we look at the differences on an hourly basis and a

total level. In addition, Twence's strategy is also taken into consideration. Finally, any risks are weighed in the decision. The case study did not make use of a risk analysis; this could also be a good follow-up study, both within Twence and in general. From the current study, it can therefore also be investigated to what extent and methods qualifying risk can contribute to a service-oriented make-or-buy analysis.

Step 5: evaluation supplier selection

In the case study, step 5 is a formal step because the case study has to be legally tendered, Twence has no choice but to use the best party from the tender as its supplier. But when the contract value is below the legal limit Twence can fulfil its procurement needs without tender methodology and can freely choose between different suppliers.

6. Conclusion

In the current situation, Twence is making use of outsourcing methodology. So the expectation is that outsourcing is the preferred option, but to confirm this expectation a literature study and case study are conducted. Due to the literature and a case study the research question “what model can be used for a make or buy analysis for building-related installations?” can be answered. The case study is performed from May 2022 till November 2022. Within this period a literature review is conducted and merged different models into a new model that can be used for the case study of Twence. The new model is a decision tree model that needs to be followed to answer the make or buy question. Based on the empirical data that is gathered during this period, Twence has an insourcing price of € [redacted] while outsourcing is € [redacted]. This results for Twence in a cost saving of € [redacted] for outsourcing the building related maintenance. Both the literature and the case study show that outsourcing of building-related maintenance is the best option for Twence.

7. Discussion

The main goal of this research was to find out if Twence could better insource or outsource their building related maintenance. After conducting the literature review, a model was created. The created model is based on financial data gathered in a time period of half year. The model is used during the case study. The results of the case study shows that outsourcing save € [redacted], so therefore, outsourcing is the preferred option. Another benefit of outsourcing besides the financial savings is risk reduction. The risk will decrease due to fact that Twence is not responsible for training the staff, which will decrease the risk of discontinuity. Therefore the outsourcing methodology fits perfectly with the strategy of Twence.

Due to fact that the different literature models are comparable, the created model is generalizable for other companies. Especially for companies that have to tender. Another aspect that stand out of the latest literature is the strategy of an organisation is important. The recommendation to Twence is therefore that future research should test the model under different circumstances, to increase the reliability of the model.

8. Appendix

Appendix A: Summary Interview manager facility and Regisseur facility 25-09-2022

Introduction to the subject:

Currently Twence is outsourcing the maintenance of building related installations. Based on outsourcing Twence is using employees and the expertise and knowledge of the supplier. Based on the strategy of Twence, Twence is willing to make use of the expertise of the supplier.

Question	Answer
But when imagining what would happen if the maintenance on building related installations were done internally at Twence?	Currently there is almost a fulltime maintenance engineer at Twence for the building related installations, when doing it internally it means that Twence need to replace this job. So Twence is need to attract new personnel for the job maintenance engineer. Twence should therefore actively look for suitable personnel for this position. Looking at the current market and what we see from the suppliers in the tender, it can be seen that the shortage of personnel is a structural problem. This structural problem can lead to discontinuities for Twence. This means that Twence can no longer present its process due to the shortage of personnel. This risk can be transferred to the supplier through outsourcing
Besides the staff shortage, the staff also needs certification to do the maintenance, What do you think about certification of own employees?	Certification is indeed an important part of the job. From Twence, the slogan "we work safely otherwise we don't work" applies. Therefore, certification in terms of safety is already necessary for a maintenance engineer. In addition, a maintenance engineer may need certification himself. That is why Twence should offer a training programme for a new staff member. This lead to the risk of getting knowledge inside the organisation. The risk here is that Twence employees need a lot of additional training and certification to stay up to date about the latest certification of the installation. The risk that will occur is that if personnel is leaving Twence, the expertise and knowledge should be rebuild which is costly.
Is there an standard training scheme for a maintenance engineer for the case study?	Currently we rely on the expertise of the current supplier and therefore their isn’t an training scheme for the case study. Therefore it necessary for the make or buy analysis to develop an training scheme for the maintenance engineer. This should include amount of training hours and the cost of it.
Currently Twence is relying on the information systems of the supplier called Planon. When insourcing the case it means that Twence needs	SAP is indeed our current ERP system, including an extension for management reporting. in practice, it is seen that in case of breakdowns

to rely on its own information system. Twence is currently working with SAP. The question that arises is whether is SAP sufficient enough to fulfil your needs as a facility department.	and maintenance, a notification is made in planon by the supplier. Within the current information systems, it is not possible to make this report and have it processed in a structured format as it currently happens via Planon. In addition, Planon offers the possibility of checking per asset component whether it still complies with the latest laws and regulations. This is in fact monitored by a team of the supplier and supplemented where necessary. It is therefore not desirable for the facility department to fall back on our own SAP system; this would require investment in facility management information system. Such as an Planon or Prequest or a competitor system.

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